

Parametric Amplifiers for Photon-Counting Detector Arrays

Completed Technology Project (2016 - 2017)



Project Introduction

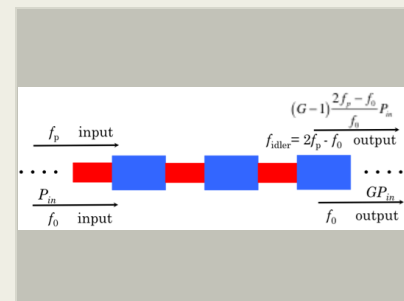
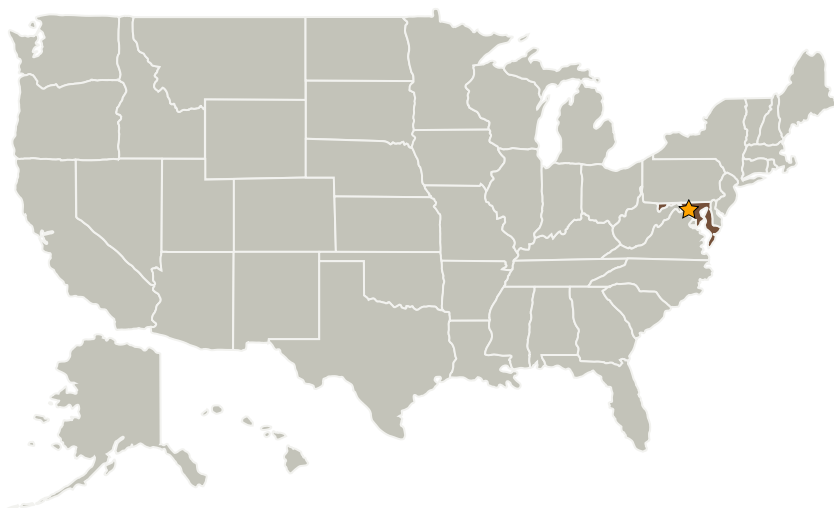
This project aims to make microwave parametric amplifiers with improved gain, bandwidth, sensitivity, and power dissipation. The amplifiers would enable revolutionary astrophysics instruments with sensitive far-infrared detectors, energy-resolving photon-counting detectors, or high-resolution x-ray microcalorimeters.

Our goal is to build high gain microwave amplifiers with improved sensitivity, increased bandwidth, and less power dissipation when operated at cryogenic temperatures. Such amplifiers would improve instrument performance in future astrophysics missions. Applications include readout of Microwave Kinetic Inductance Detectors (MKIDs) with single-photon sensitivity in the far infrared, or energy-resolving capabilities in the near infrared through ultraviolet, or in x-ray microcalorimeters with multiplexed microwave SQUID amplifier (mSQUID) readout systems.

Anticipated Benefits

Applicable in ground-based demonstration instruments for astrophysics. Provide lower amplifier noise temperature and lower power dissipation than state-of-the art High Electron Mobility Transistors over a wide bandwidth.

Primary U.S. Work Locations and Key Partners



In the type of parametric amplifier being developed in this project, a small microwave signal and a large amplitude pump wave are input. The amplifier outputs are an amplified signal at the original signal frequency, as well as an...

Table of Contents

Project Introduction	1
Anticipated Benefits	1
Primary U.S. Work Locations and Key Partners	1
Project Transitions	2
Organizational Responsibility	2
Project Management	2
Images	3
Links	3
Technology Maturity (TRL)	3
Technology Areas	3
Target Destination	3

Parametric Amplifiers for Photon-Counting Detector Arrays

Completed Technology Project (2016 - 2017)



Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations

Maryland

Project Transitions

**October 2016:** Project Start**September 2017:** Closed out

Closeout Summary: The purpose of the Goddard Space Flight Center's Internal Research and Development (IRAD) program is to support new technology development and to address scientific challenges. Each year, Principal Investigators (PIs) submit IRAD proposals and compete for funding for their development projects. Goddard's IRAD program supports eight Lines of Business: Astrophysics; Communications and Navigation; Cross-Cutting Technology and Capabilities; Earth Science; Heliophysics; Planetary Science; Science Small Satellites Technology; and Suborbital Platforms and Range Services. Task progress is evaluated twice a year at the Mid-term IRAD review and the end of the year. When the funding period has ended, the PIs compete again for IRAD funding or seek new sources of development and research funding or agree to external partnerships and collaborations. In some cases, when the development work has reached the appropriate Technology Readiness Level (TRL) level, the product is integrated into an actual NASA mission or used to support other government agencies. The technology may also be licensed out to the industry. The completion of a project does not necessarily indicate that the development work has stopped. The work could potentially continue in the future as a follow-on IRAD; or used in collaboration or partnership with Academia, Industry and other Government Agencies. If you are interested in partnering with NASA, see the TechPort Partnerships documentation available on the TechPort Help tab. <http://techport.nasa.gov/help>

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Center Independent Research & Development: GSFC IRAD

Project Management

Program Manager:

Peter M Hughes

Project Managers:

Terence A Doiron
Megan E Eckart
Timothy D Beach

Principal Investigator:

Thomas R Stevenson

Co-Investigators:

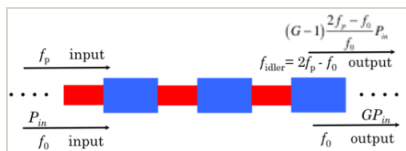
Ari D Brown
Megan E Eckart
Negar Ehsan
Edward J Wollack

Parametric Amplifiers for Photon-Counting Detector Arrays



Completed Technology Project (2016 - 2017)

Images

**Parametric amplifier**

In the type of parametric amplifier being developed in this project, a small microwave signal and a large amplitude pump wave are input. The amplifier outputs are an amplified signal at the original signal frequency, as well as an idler tone.

(<https://techport.nasa.gov/image/26036>)

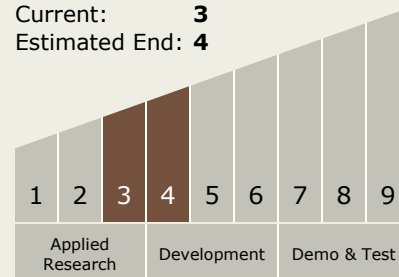
Links

GSC-17504-1
(no url provided)

GSC-17996-1
(no url provided)

Technology Maturity (TRL)

Start: **3**
Current: **3**
Estimated End: **4**



Technology Areas

Primary:

- TX08 Sensors and Instruments
 - └ TX08.1 Remote Sensing Instruments/Sensors
 - └ TX08.1.1 Detectors and Focal Planes

Target Destination

Outside the Solar System